

The CASSINI Ka-Band Gravitational Wave Experiments

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ABSTRACT

The detection of gravitational radiation is one of the most challenging efforts in the physics of this century. A successful observation will not only represent a great triumph in experimental physics, but will also provide a new observational tool for obtaining a better and deeper understanding about its sources, as well as a unique test of the proposed relativistic theories of gravity [1].

Experiments aimed at the detection of gravitational waves via Doppler tracking of interplanetary spacecraft have been performed at the Jet Propulsion Laboratory (JPL) over the past two decades [2]. Unfortunately none of those attempts led to an unambiguous detection.

On November 29, 2001, the CASSINI spacecraft will be continuously tracked at Ka-Band for a period of forty days, and at an anticipated sensitivity level never achieved before. This talk provides an overview of the CASSINI onboard radio configuration, as well as the Ka-Band implementation at one of the 34 meters beam wave-guide antennae of the NASA Deep Space Network (DSN). The stringent frequency stability requirements on the coherent microwave link between the DSN station and the spacecraft have implied the implementation of superior ground station stability, and sophisticated calibration of the frequency fluctuations due to the atmosphere. Specific capabilities added to one of the DSN 34-m beam wave-guide include stable frequency and timing, precision Ka-Band pointing, and an extremely low noise Ka-band receiver. A summary of the anticipated CASSINI sensitivities to specific gravitational wave forms will then be presented as part of our conclusions.

REFERENCES

- [1] K.S. Thorne, in *300 Years of Gravitation*, edited by S.W. Hawking and W. Israel (CUP, England, 1987)
- [2] J.W. Armstrong, *Radio Science*, **33**, 1727 - 1738, (1998).